International Standard

ISO 9073-7

Second edition
2024-11

Nonwovens — Test methods —

Part 7: Determination of bending length

Nontissés — Méthodes d'essai —

Partie 7: Détermination de la longueur de flexion

Reference number
ISO 9073-7:2024(en)

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Published in Switzerland

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 38, *Textiles,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 248, *Textiles and textile products,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 9073-7:1995), which has been technically revised.

The main changes are as follows:

— the title has been changed from "*Textiles — Test methods for nonwovens — Part 7: Determination of bending length*" to "*Nonwovens — Test methods — Part 7: Determination of bending length*";

— Figure 1 has been corrected according to ISO/IEC Directives, Part 2;

— Figure A.1 has been corrected according to ISO/IEC Directives, Part 2;

— through the document, "test piece" has been replaced by "test specimen";

— numbering of NOTE has been corrected according to ISO/IEC Directives, Part 2;

— Bibliography has been added to list the informative references described in 8.2 and A.3.

A list of all parts in the ISO 9073 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Nonwovens — Test methods —

Part 7: Determination of bending length

SAFETY WARNING — This document does not claim to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. It is expected that the person performing this test has been fully trained in all aspects of this procedure.

1 Scope

This document specifies a method for determining the bending length of a nonwoven. A formula is given for calculating the flexural rigidity of the nonwoven material from the bending length. The method is not applicable to combination-type materials (composites or laminates) in which there can be a natural twist.

NOTE This document describes a test method specific to nonwovens.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 186, *Paper and board — Sampling to determine average quality*

ISO 9073-1, *Nonwovens — Test methods — Part 1: Determination of mass per unit area*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
bending length
length of a rectangular strip of nonwoven, fixed at one end and free at the other, that will bend under its own weight to an angle of 7,1°

3.2
flexural rigidity
ratio of small changes in bending moment per unit width of the material to corresponding small changes in curvature expressed in mN·cm

Note 1 to entry: Flexural rigidity can be calculated from the bending length.

Note 2 to entry: Flexural rigidity is expressed in mN·cm.

Note 3 to entry: This quantity is a measure of the resistance of the nonwoven to bending by external forces. It is related to the quality of stiffness that is appreciated when a nonwoven is handled, in the sense that the nonwoven having a high flexural rigidity tends to feel stiff.

4 Principle

A rectangular strip of nonwoven is supported on a horizontal platform with the long axis of the strip parallel to the long axis of the platform. The strip is advanced in the direction of its length so that an increasing part overhangs the platform and bends down under its own weight. The overhang is free at one end, and fixed at the other from the pressure applied by a slide on the part of the test specimen still on the platform."

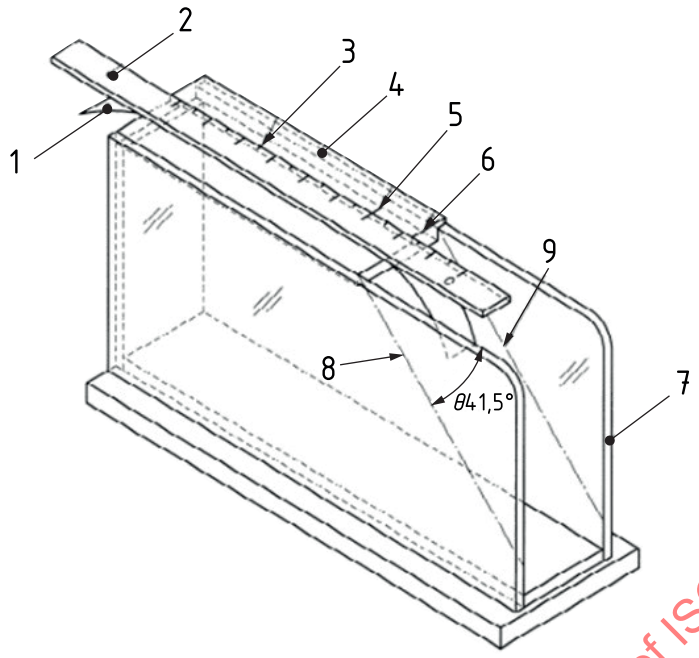
When the leading edge of the test specimen has reached a plane passing through the edge of the platform and inclined at an angle of 41,5° below the horizontal, the overhanging length will equal twice the bending length of the test specimen (see Annex A), and thus the bending length can be calculated.

5 Apparatus

5.1 Level table.

5.2 Platform, of width (40 ± 2) mm and length (200 ± 2) mm, supported at a height of at least 150 mm above the surface of the table (5.1). Each side of the platform support shall be transparent and marked with a line (L1, and L, respectively; see Figure 1) running from the end of the platform at an angle of 41,5º below the horizontal. A mark (D) shall be made on the platform at (10 ± 1) mm from the front edge (see Figure 1).

To avoid adherence of the test specimen, the platform should be coated or covered with polytetraf luoroethylene (PTFE).



Key

1 test specimen
2 steel rule
3 scale
4 platform
5 n (mark)
6 front edge of platform
7 platform support
8 L_1
9 L_2

Figure 1 — Apparatus for measuring bending length

5.3 Steel rule width (25 ± 1) mm, length (350 ± 1) mm and mass (250 ± 10) g, accurately graduated in millimetres, and with a rubber-covered underside.

NOTE A rule made of steel plate 3,5 mm thick will have the correct mass.

5.4 Means of measuring time, to an accuracy of ±1 s.

6 Sampling

Carry out sampling in accordance with ISO 186.

7 Preparation and conditioning of test specimens

7.1 Cut out six test specimens (25 ± 1) mm x (250 ± 1) mm with their long edges parallel to the nonwoven manufacturing machine direction (MD) and an equal number of test specimens with their long edges in the perpendicular, or cross-machine, direction (CD). The test specimens shall be taken at least 50 mm from the

edge of the sample. The test specimens shall not be cut from end pieces, creased or folded places. Handle the sample and the test specimens as little as possible.

Nonwovens which tend to curl or twist should be conditioned before cutting out the test specimens. If the test specimens curl or twist seriously, they can often be made to lie flat long enough for testing by pressing lightly between flat surfaces for several hours.

NOTE 1 Additional samples can be taken at an angle of 45° to the machine direction.

NOTE 2 For production control, the number of test specimens are limited to three in each direction (MD and CD).

7.2 Condition the test specimens and carry out the test in one of the standard atmospheres specified in ISO 139.

8 Procedure

8.1 Weigh the test specimen and calculate the mass per unit area in grams per square metre in accordance with ISO 9073-1.

8.2 Place the apparatus on the level table (5.1). Place the test specimen on the platform with one end coinciding with the front edge of the platform. Place the steel rule (5.3) on the test specimen with the zero of the scale in line with the mark D on the platform.

Push the steel rule forward so that the test specimen projects over the front edge of the platform and bends down under its own weight. Move the rule forward at a constant speed (this can be facilitated by using an apparatus fitted with a motorized drive, see note hereafter) until the overhanging end of the test specimen reaches the two lines on the platform support L_1 and L_2. After an interval of (8 ± 2) s, read on the scale on the steel rule the overhanging length of the test specimen. The speed of movement of the rule shall be determined (for example, uniform rate of approximately 25 mm in 5 s).

NOTE Information on a suitable apparatus fitted with a motorized drive are provided in References [3] and [4].

8.3 Repeat the operation in 8.2 with the other face of the test specimen up, and again at the other end of the test specimen, first with the original face up and then with the test specimen turned over.

NOTE It can be helpful to place the apparatus so that the zero of the scale on the rule lies towards the observer and at a level that enables the scale to be read with comfort. The position of the end of the test specimen relative to L_1, and L_2, can be observed in a mirror suitably placed or attached to one side of the apparatus.

9 Expression of results

9.1 Taking the bending length to be half the length of the overhang, record the four values of the bending length for each test specimen and from these calculate the mean bending length for each test specimen.

9.2 Then calculate the overall mean bending length, C, in centimetres, for the six test specimens cut in the machine direction.

Calculate the same parameter separately for the six test specimens cut in the cross-machine direction.

9.3 Calculate the mean flexural rigidity, G, per unit width, in millinewton per centimetres, separately for the machine direction and the cross-machine direction test specimens, using Formula (1):

$$G = m \times C^3 \times 9{,}81^{-3} \quad (1)$$

where

m is the mass of the test specimen per unit area, in grams per square metre;

C is the overall mean bending length, in centimetres, of the test specimen.

NOTE In determining this formula, the acceleration due to gravity, 9,81 m/s^2, has been rounded to 10 m/s^2.

9.4 Calculate the coefficient of variation (ratio of the standard deviation to the average) for C and G in both machine direction and cross-machine direction.

10 Test report

The test report shall include the following information:

a) a reference to this document, i.e. IS0 9073-7:2024;

b) all details necessary for the identification of the material;

c) date of the test;

d) number of measurements taken;

e) number of MD test specimens tested;

f) number of CD test specimens tested;

g) overall mean bending length and coefficient of variation of the test material for the machine direction;

h) overall mean bending length and coefficient of variation of the test material for the cross-machine direction;

i) mean flexural rigidity and coefficient of variation of the test material for the cross-machine direction (CD);

j) mean flexural rigidity and coefficient of variation of the test material for the machine direction (MD);

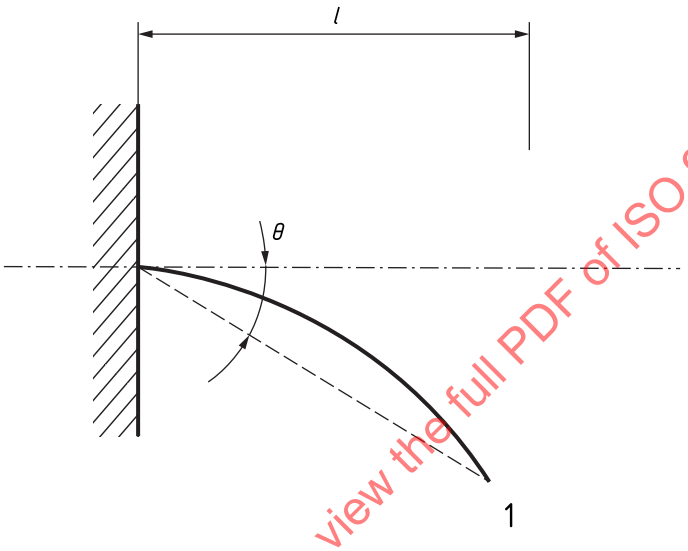
k) any unusual features noted during the testing or deviations from the procedure specified in this document.

Annex A
(normative)

Flexural rigidity, bending length and overhanging length

A.1 Measurement of flexural rigidity

Flexural rigidity can be expressed as a function of the deflection of a cantilever submitted to its own weight by Figure A.1 and the following formula (only valid for small deformations):



Key
1 test specimen

Figure A.1 — Measurement of flexural rigidity

$$G = \frac{1}{\frac{\tan\theta}{\cos(0{,}5\theta)}} \cdot \frac{\rho l^3}{8} \quad \text{(A.1)}$$

where

G is the flexural rigidity (per unit width);

θ is the angular deflection of the cantilever end;

ρ is the own weight per unit area (= mass per unit area × acceleration due to gravity);

l is the cantilever length.

A.2 For $\theta = 7{,}1°$:

$$\frac{\tan\theta}{\cos(0{,}5\,\theta)} = \frac{1}{8}$$

Let $l = C$ (bending length)

then

$$G = pC^3 \qquad \text{(A.2)}$$

A.3 For ease of measurement, the method given in this document uses the cantilever length corresponding to the angular deflection θ= 41,5°.

For $\theta = 41{,}5°$:

Let $2 = L$ (overhanging length)

It can be shown that

$$G = \frac{pL^3}{8} \qquad \text{(A.3)}$$

On comparison with Formula (A.1), we see that

$$G = \frac{pL^3}{8} = pC^3 \text{ and}$$

$$C = \frac{L}{2}$$

Therefore, the bending length is half the overhanging length.

NOTE See References [1] and [2].